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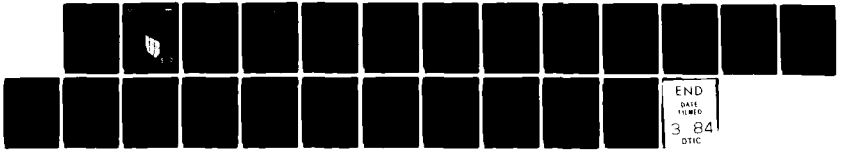

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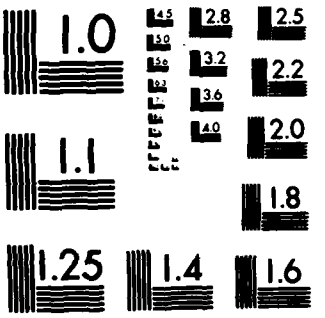

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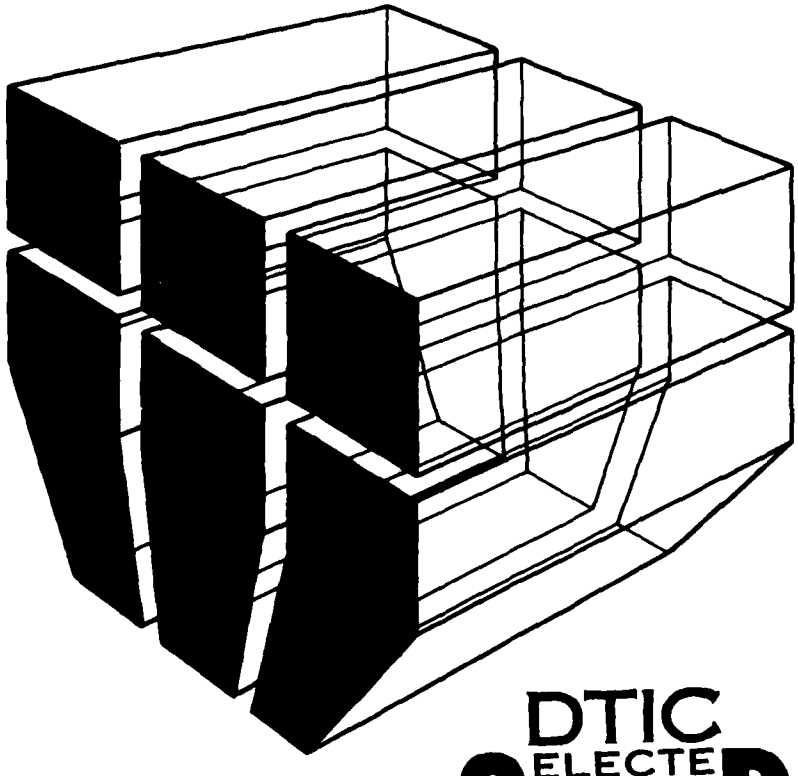
TECHNICAL REPORT N-170
December 1983
Hazardous Materials Management System

INTERACTIVE HAZARDOUS MATERIALS INFORMATION SYSTEM (HMIS): DESCRIPTION AND ASSESSMENT

AD A138329

by
Manette Messenger
Ronald D. Webster
Calvin C. Corbin
Lester Pritchard



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The Hazardous Materials Management System (HMMS) is a computerized system being developed to help Army fixed facilities identify chemical substances subject to the requirements of the Resource Conservation and Recovery Act and AR 200-1, and to provide handling information on those substances. One of the HMMS subcomponents is an interactive program to search the Defense Logistic Agency's Hazardous Materials Information System (HMIS) database. This report describes the development and use of an interactive version of HMIS and the use of this interactive system to assess the HMIS

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database. Assessment of the database showed that the data were incomplete, inconsistent, and sometimes incorrect. To solve this problem, users should search the database with assigned search terms so that as many records as possible on a specific compound can be retrieved.

FOREWORD

This research was performed for the Assistant Chief of Engineers under Project 4A762720A896, "Environmental Quality for Construction and Operation of Military Facilities"; Task A, "Installation Environmental Management Strategy"; Work Unit 034, "Hazardous Materials Management System." The work was performed by the Environmental Division (EN) of the U.S. Army Construction Engineering Research Laboratory (CERL). Ms. Marcia Read, DAEN-ZCF-U, is the Technical Monitor.

Dr. R. K. Jain is Chief of EN. COL Paul J. Theuer is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

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INTERACTIVE HAZARDOUS MATERIALS INFORMATION SYSTEM (HMIS): DESCRIPTION AND ASSESSMENT

1 INTRODUCTION

Background

The Army developed the Hazardous Materials Management System (HMMS)[1] to provide information on identifying, handling, and regulating hazardous chemical substances subject to Resource Conservation and Recovery Act (RCRA) hazardous waste regulations as implemented by Army Regulation 200-1.[2] The Department of Defense (DOD) has designated the Defense Logistics Agency (DLA) as the lead agency for implementing regulations dealing with hazardous waste disposal.

In 1978, DLA began developing the Hazardous Materials Information System (HMIS) to provide information to the field about the chemical/physical properties of all hazardous items procured by DOD agencies and guidance on the proper procedures for handling them. HMIS is disseminated to the field on microfiche which is updated quarterly. The data can be "looked at" using the national stock number (NSN), the DLA storage code, the National Institute of Occupational Safety and Health (NIOSH) code, or the Department of Transportation (DOT) hazard class. DLA has not provided a mechanism for locating the data by chemical name, trade name, or generic name, although their database contains this information. Often, however, at the installation level, the only information available on a chemical substance is its chemical name or trade name; the stock number is not always readily available. Therefore, to make the HMIS database more accessible and useful to field users, the U.S. Army Construction Engineering Research Laboratory (CERL) obtained the data from DLA on magnetic tape and implemented interactive software to make it searchable by chemical name, trade name, and generic name, as well as by NSN and storage code. The pilot system is readily available to field users as an Environmental Technical Information System (ETIS)[3] subsystem under the experimental (XPER) module. The system may be accessed by all Department of Defense agencies, over toll-free FTS, and by TELENET phone numbers.

Objective

The objectives of this report are to describe the development and use of the interactive HMIS and to assess the HMIS database as it is currently implemented.

Approach

The pilot system was used to assess HMIS database in terms of the completeness, consistency, and validity of its data.

Mode of Technology Transfer

It is recommended that the interactive HMIS be transferred in accordance with the provisions of AR 18-1, Army Automation Management, upon acceptance of the pilot HMMS by the Department of the Army. Recommendations will be solicited from the HMMS user group regarding proponency, implementation alternatives, and necessary modifications to the pilot system.

2 INTERACTIVE HMIS COMMAND LANGUAGE

The second and third subsystems of the Hazardous Materials Management System (HMMS) are programs that allow interactive searches of DLA's HMIS safety and transportation databases. Searches can be conducted using national stock numbers, chemical names and synonyms, trade names, generic names, military specifications, item manager, Federal Supply Classification for Manufacturers (FSCM), NIOSH code of ingredients, chemical names of ingredients, DOT shipping name and class, and the DLA storage code as search terms, or keywords. Retrievable fields include identifiers, formulation, health information, chemical/physical properties, handling and spill control, fire and explosion hazards, and DOT requirements. Tables 1 and 2 list the searchable and retrievable fields for the safety and transport subsystems. These fields have been selected from the total DLA database on the basis of presumed usefulness to the Army installation. They do not represent the complete DLA database.

[1] M. Messenger, et al., *Status of Hazardous Materials Management System (HMMS)*, Draft Technical Report (U.S. Army Construction Engineering Research Laboratory [CERL]).

[2] *Environmental Protection and Enhancement*, Army Regulation 200-1 (Department of the Army, 15 June 1982).

[3] R. D. Webster, et al., *Modification and Extension of the Environmental Technical Information System (ETIS) for the Air Force*, Special Report N-8/ADA079441 (CERL, 1979).

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Table 1
Datafields in the HMIS Safety Subsystem

Searchable Fields

- NSN
- FSCM
- trade name
- chemical name
- generic name
- specification
- item manager
- storage code
- NIOSH codes of ingredients
- chemical names of ingredients

Retrievable Fields

1. General Information (group name: names)
   - NSN
   - trade name
   - chemical name
   - generic name
   - chemical family
   - chemical formula
   - FSCM
   - specification
   - item manager
   - manufacturer's name
   - manufacturer's phone number
2. Formulation (group name: formulation)
   - first component
   - first NIOSH code
   - % first component
   - TLV first component
   - second component
   - second NIOSH code
   - % second component
   - TLV second component
   - third component
   - third NIOSH code
   - % third component
   - TLV third component
   - fourth component
   - fourth NIOSH code
   - % fourth component
   - TLV fourth component
   - fifth component
   - fifth NIOSH code
   - % fifth component
   - TLV fifth component
3. Chemical and Physical Properties (group name: properties)
   - boiling point
   - vapor pressure
   - vapor density
   - solubility
   - specific gravity
   - % volatile
   - evaporation rate
   - appearance and odor
   - flash point
   - lower explosive limit
   - upper explosive limit
4. Fire and Explosion Hazards (group name: fire)
   - flash point
   - extinguishing media
   - fire fighting procedures
   - unusual hazards
   - stability
   - conditions to avoid
   - incompatible materials
   - decomposition products
5. Health Information (group name: health)
   - effects of overexposure
   - TLV for mixture
   - emergency first aid
   - respiratory protection
   - ventilation
   - protective gloves
   - eye protection
   - protective equipment
6. Handling and Spill Information (group name: handling)
   - storage code
   - spill and leak control
   - waste disposal method
   - handling and storage precautions
   - other precautions

Table 2
Datafields Contained in the HMIS Transport Subsystem

Searchable Fields:

- NSN
- part number
- DOT shipping name
- DOT class
- focal point indicator
- FSCM
- UN number
- UN class

Retrievable Fields: (one group)

- NSN
- part njmber
- unit of issue
- container size
- container type
- net weight
- flash point
- auto ignition temp
- transport group
- ammo compatibility group
- DOT shipping name
- DOT class
- DOT label
- focal point indicator
- FSCM
- UN number
- UN class
- identification number
- reportable quantity

The command languages for the safety and transport subsystems are identical, with two basic types of commands needed. Search commands are used with the searchable keywords to retrieve the data records of interest to the user from computer storage. Display commands are used to print portions or all of the data records that were retrieved with the prior search command.

Search Commands

The prompt for the system is a colon; when the system responds with a colon, that means it is waiting for a command to come from the user. Four search commands are associated with the interactive HMIS systems. These commands can be used either on the keywords or on fragments of the keywords.

find <keyword name> find <$fragment>	Locates all records in total database that contain the specified keyword, e.g.: find 1,1,1-trichloroethylene; find $trichlor.
and <keyword name> and <$fragment>	Searches the group of records selected by the previous "find" command for those that also contain this specific keyword, e.g.: and alk-tri solvent; and $alk.
or <keyword name> or <$fragment>	Searches the whole database for records containing the specified keyword and adds them to the group of records selected by the previous "find," e.g.: or naphthalene, technical; or $naphtha.
except <keyword name>	Searches the group of records selected by the previous "find" or "or" command, removes those containing the keyword, e.g.: except neu-tri solvent; except $neu.

The group of selected records is reinitiated with a new find command. Keyword names are written completely in lower case, including any letters that appear as part of an NSN. As seen in Tables 3 and 4, keyword names can be NSNs, trade names, chemical names, item (generic) names, and DLA storage codes in the safety subsystem, and NSNs, part numbers, DOT shipping names, and DOT classes in the transport subsystem. Fragment searches, which must be identified with a "$" before the fragment, take about 90 seconds to complete.

Table 3
Various Ways Trichloroethane Is Specified in the Raw HMIS Database

1,1,1-trichloroethane
1,1,1 trichloroethane
1,1,1 trichloroethane, technical
1,1,1 trichloroethane, inhibited
1,1,1 trichloroethane, technical
1,1,1 trichloroethane, technical, inhibited
1,1,1 trichloroethane/perchlorethylene
1,1,1 trichloroethane, inhibited
1,1,1-trichloroethane
1,1,1-trichloroethane, technical
1,1,1-trichloroethane, inhibited
1,1,1-trichloroethane, technical
1,1,1-trichloroethane; methylchloroform.
trichloroethane, technical
trichloroethane, technical

Table 4
Various Ways Naphtha Is Specified in the Raw HMIS Database

naphtha
naphtha, aliphatic
naphtha aromatic, liquid form
naphtha solvent
naphtha, solvent
naphtha,aliphatic
naphtha;aliphatic
naphtha,aromatic
naphtha,cleaner
naphthalene,technical
naphtha,solvent,aliphatic aromatic mixture
naphtha,solvent,aliphatic-aromatic mixture
petroleum solvent

Display Commands

Once the user has located the records of interest in the database by using one or more search commands, a number of options are available for printing them out. The list command is common to both the safety and transport subsystems; it can be used in two ways.

list all	Produces a printout of the information contained in all the data fields for the selected records (see Tables 1 and 2).
list <field name>	Produces a printout of the information contained in just the specified fields for the selected records, e.g.: list trade name, flash point, ventilation.

As many fields as desired can be used with the list command; they must be separated by commas, with no spaces.

To consolidate the information into logical groups, the safety subsystem has an additional command for printing the data. The 53 separate datafields have been arranged into six groups containing related information: identifiers, formulation, chemical/physical properties, fire and explosion hazards, health factors, and handling and spill cleanup. Table 1 shows the datafields contained in each group and the valid group names. All the datafields contained in any group can be printed using the display command:

display <group names>	Produces a printout of the information contained in the data fields for those groups, e.g.: display names, properties, handling.

The group names are separated by commas, with no spaces.

Other Commands

show fields	Prints the names of the datafields that can be used with the list command. These are the same lists shown in Tables 3 and 4.
show <field name>	Prints all the actual keywords found in the raw databases, just for the searchable fields. This produces quite a lengthy listing (~19,000 safety, ~20,000 transport).
save <filename>	Saves the current group of records in either the safety or transport subsystem for restoration in the other. Serves as a link between the two systems to avoid the need to repeat lengthy searches. Filename is any 1- through 14-character name that the user chooses.
restore <filename>	Recalls the records previously saved in the sister subsystem. Those records are instantly ready to be listed, without using any of the search commands.
bye end quit	To leave the systems

3 ASSESSMENT OF THE HMIS DATABASE

HMIS data comes solely from material safety data sheets (MSDS) (Figure 1) obtained from the manufacturer of each product. Unfortunately, the only information mandatory on an MSDS is the national stock number and the contract number under which the item is procured. Many manufacturers do not provide the rest of the information requested on the MSDS. As a result, the HMIS databases are incomplete. A search of the database, using the interactive software developed by CERL, showed that 53 percent of all the datafields in the safety database have been left blank, and 29 percent of the item (generic) names and 73 percent of the chemical names are missing. In the transport database, 56 percent of all datafields, 12 percent of the DOT shipping names, and 42 percent of the DOT classes are lacking. In the interactive HMIS system, the words "no data" indicate that that field has been left blank; other terms, such as "n/a" and "none," have been input by DLA.

Besides lacking nearly half the relevant information for each chemical, the HMIS databases are missing a complete list of NSNs synonymous with each chemical name. This is a problem, because HMIS is an NSN-based system; that is, the NSN is the entry point used to retrieve data on chemical names and trade names. The Federal Supply Classification System (FSC), which assigned NSNs to items to be procured, is a DLA function; therefore, it would be useful to make a complete list of all NSNs synonymous with a particular chemical name. This could be done by computer searches through the master cross reference list (MCRL) which correlates item names with NSNs. It would be preferable to implement this sort of organized approach toward combining the HMIS databases. CERL obtained the MCRL and searched it for four common chemicals. The NSNs resulting from this search were then compared to those found in the HMIS databases for the same chemical name. The HMIS databases were found to contain 47 percent of the relevant NSNs for trichloroethylene, 16 percent for methanol, 32 percent for benzene, and 20 percent for acetone. Thus, with the current system, there is a danger that users who fail to find a particular NSN in the HMIS databases may assume a particular material is not hazardous when, in fact, it is.

Another problem is that the NSNs in the HMIS databases are not unique. New NSNs are assigned to chemical products based on different degrees of purity and different sizes of containers. In the current HMIS, 25 percent of the NSNs in the safety database and 19 percent of those in the transport database are associated with more than one record. Clearly, this repetition of stock numbers stems from the practice of basing the HMIS databases completely on MSDS's and disregarding other sources of data, including information already in the HMIS. Consolidating or comparing the information from different manufacturers of the same chemical compound would provide a way of filling some of the gaps in the databases and checking the validity of the data being supplied by different manufacturers.

Some of the data in HMIS are incorrect, sometimes dangerously so. This was illustrated by a simple test performed on the safety database. Using the assigned search terms for trichloroethylene, methyl ethyl ketone, and xylene, all the data records for these pure chemicals were pulled out of the database and stored in separate files—one for each chemical. (All three of these chemicals are common solvents widely used throughout industry and the Army: their properties and handling requirements are well known and widely available.) The computer then sorted the file containing the records for each chemical so all the same datafields were grouped together; i.e., all the handling requirements for trichloroethylene were in one place and could be compared. This exercise showed that much of the data in the HMIS databases are wrong. Figures 2, 3, and 4 are examples of some of the incorrect data found.

Figure 2 contains selected datafields for the 13 records found in the HMIS safety database for methyl ethyl ketone (MEK). All records selected deal with 98 to 100 percent, or essentially pure, MEK. The first problem of note is that only 9 of the 13 NSNs found in HMIS are unique; the other four are repeats. A comparison of this list with the MCRL shows that HMIS includes 9 out of the possible 19 stock numbers under which MEK is procured.

The second datafield shown in Figure 2 is vapor pressure. This varies from 70 to 100, with no unit of measurement given. The solubility data vary from 25 percent to 27.1 percent to "appreciable" to "very soluble" to "no data" for 6 of the 13 records. Using similar techniques for collecting and sorting data, some of the "no data" gaps could be filled in, and vague terms, such as "appreciable," could be weeded out without consulting any other references. It would also be possible to identify probable errors, such as a vapor pressure given as 100 when all the rest are around 70.

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U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1367

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: ADE TECHNOLOGY CORPORATION	EMERGENCY TELEPHONE NO.: 866-7744
ADDRESS (Number, Street, City, State, and ZIP Code): 7301 W. Wilson, Harwood Heights, IL 60656	
CHEMICAL NAME AND SYNONYMS: Tritium	TRADE NAME AND SYNONYMS: Tritium T-Light
CHEMICAL FAMILY: Hydrogen	FORMULA: H_3

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	0		BASE METAL	0	
CATALYST	0		ALLOYS	0	
VEHICLE	0		METALLIC COATINGS	0	
SOLVENTS	0		FILLER METAL PLUS COATING OR CORE FLUX	0	
ADDITIVES	0		OTHERS	0	
OTHERS	0				

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
	0	
GAS	0	
	0	
	0	

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	NA	SPECIFIC GRAVITY (H_2O=1)	NA
VAPOR PRESSURE (mm Hg.)	NA	PERCENT, VOLATILE BY VOLUME (%)	NA
VAPOR DENSITY (AIR=1)	NA	EVAPORATION RATE (_____ =1)	NA
SOLUBILITY IN WATER	NA		
APPEARANCE AND ODOR	Colorless and odorless		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): NA	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA: NA			
SPECIAL FIRE FIGHTING PROCEDURES: NA			
UNUSUAL FIRE AND EXPLOSION HAZARDS: NONE			

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Figure 1. Example MSDS.

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SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: 5 RAM per year

EFFECTS OF OVEREXPOSURE: none

EMERGENCY AND FIRST AID PROCEDURES: air vent work area

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID: fire or flame
	STABLE		NA

INCOMPATABILITY (Materials to avoid): NA

HAZARDOUS DECOMPOSITION PRODUCTS: NA

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR		NA

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Air vent work area

WASTE DISPOSAL METHOD: Dispose broken sources at low levels

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Self-contained air

VENTILATION	LOCAL EXHAUST: 50 FPM only in work area	SPECIAL: NA
	MECHANICAL (General): NA	OTHER: NA

PROTECTIVE GLOVES: NA

EYE PROTECTION: NA

OTHER PROTECTIVE EQUIPMENT: NA

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: More than 5 air changes only in area where risk of breakage exists.

OTHER PRECAUTIONS: none

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Figure 1. Cont'd.

nsn:	6810000799419	6810000799419	methyl ethyl ketone
nsn:	6810002648983	6810001834400	methyl ethyl ketone
nsn:	6810002812762	6810001856983	methyl ethyl ketone
*nsn:	6810002812762	6810002648983	methyl ethyl ketone
nsn:	6810002812763	6810002812762	methyl ethyl ketone
nsn:	6810002812785	6810002812763	methyl ethyl ketone
nsn:	6810002816929	6810002812785	methyl ethyl ketone
*nsn:	6810002816929	6810002816929	methyl ethyl ketone
nsn:	6810003077234	6810002907104	methyl ethyl ketone
nsn:	6810006878429	6810003077234	methyl ethyl ketone
*nsn:	6810006878429	6810003949395	methyl ethyl ketone
nsn:	6810009857098	6810004166822	methyl ethyl ketone
*nsn:	6810009857098	6810004727967	methyl ethyl ketone
		6810006878429	methyl ethyl ketone
HMIS contains 13 records,		6810008238052	methyl ethyl ketone
9 unique NSNs		6810009738886	methyl ethyl ketone
		6810009751530	methyl ethyl ketone
*repeated stock numbers		6810009857098	methyl ethyl ketone
		6810010745507	methyl ethyl ketone
		Federal Supply System contains 19 NSNs under which MEK is procured.	

vapor pressure:	no data	solubility:	no data
vapor pressure:	no data	solubility:	no data
vapor pressure:	no data	solubility:	no data
vapor pressure:	70	solubility:	no data
vapor pressure:	71	solubility:	27.1%
vapor pressure:	71	solubility:	no data
vapor pressure:	100	solubility:	very solubl
vapor pressure:	no data	solubility:	no data
vapor pressure:	75	solubility:	27%
vapor pressure:	100	solubility:	appreciable
vapor pressure:	70	solubility:	25%
vapor pressure:	70	solubility:	26.8% by wt
vapor pressure:	71	solubility:	27.1

extinguishing media: no data
extinguishing media: no data
extinguishing media: no data
extinguishing media: alcohol foam, co*2, dry chemical
extinguishing media: carbon dioxide, dry chemical, foam, water spray ineffective
extinguishing media: carbon dioxide, dry chemical or foam, water spray no effect
extinguishing media: water spray, alcohol foam, dry chemical or co*2
extinguishing media: no data
extinguishing media: alcohol foam, carbon dioxide, dry chemical, water spray/fog
extinguishing media: foam, water spray, dry chemical or co*2
extinguishing media: alcohol foam, carbon dioxide or dry chemical
extinguishing media: alcohol-foam; carbon dioxide or dry chemical
extinguishing media: carbon dioxide, dry chemical, alcohol type foam

unusual hazards: no data
unusual hazards: no data
unusual hazards: no data
unusual hazards: no data
unusual hazards: serious fire hazard because of its low flash point, high volatility
unusual hazards: serious fire hazard because of its low flash point, high volatility
unusual hazards: n/a
unusual hazards: no data
unusual hazards: none
unusual hazards: flamm. vapor may spread away from spill
unusual hazards: none
unusual hazards: reacts with oxidizers
unusual hazards: serious fire hazard because of low flash point, high volatility

Figure 2. Raw data from HMIS safety database showing missions, inconsistencies, and errors in information given for 98 to 100 percent pure methyl ethyl ketone (MEK).

conditions to avoid: no data
conditions to avoid: no data
conditions to avoid: no data
conditions to avoid: sparks and open flame
conditions to avoid: none
conditions to avoid: none
conditions to avoid: heat, spark and open flame
conditions to avoid: no data
conditions to avoid: sparks and open flame
conditions to avoid: heat, sparks, and open flame
conditions to avoid: no data
conditions to avoid: keep away from sources of ignition
conditions to avoid: heat, spark, open flame

incompatible materials: no data
incompatible materials: no data
incompatible materials: no data
incompatible materials: strong oxidizing agents.
incompatible materials: alkanol, amines, pyridines, ammonia, caustics, inorganic acids
incompatible materials: alkanol, amines, pyridines, ammonia, caustics, inorganic acids
incompatible materials: no data
incompatible materials: no data
incompatible materials: strong oxidizing agents
incompatible materials: no data
incompatible materials: none
incompatible materials: oxidizers
incompatible materials: alcohol, amines, pyridines, ammonia, see other precaution sect

decomposition products: no data
decomposition products: no data
decomposition products: no data
decomposition products: no data
decomposition products: none
decomposition products: none
decomposition products: no data
decomposition products: no data
decomposition products: no data
decomposition products: no data
decomposition products: thermal decomp - carbon dioxide and carbon monoxide
decomposition products: carbon monoxide and carbon dioxide
decomposition products: none

fire fighting procedures: no data
fire fighting procedures: no data
fire fighting procedures: no data
fire fighting procedures: no data
fire fighting procedures: close or confined areas require self contained breather
fire fighting procedures: close or confined quarters require self contained breather
fire fighting procedures: n/a
fire fighting procedures: no data
fire fighting procedures: mek is very volatile and extremely flammable
fire fighting procedures: water spray is ineffective for extinguishment, use for cooling
fire fighting procedures: none
fire fighting procedures: no data
fire fighting procedures: use self contained breathing apparatus in confined areas

Figure 2. Cont'd.

nsn:	6810001844800	6505007209413	trichloroethylene, n
nsn:	6810002232731	6505008678257	trichloroethylene, n
nsn:	6810007542813	6810001844794	trichloroethylene, t
nsn:	6810009247107	6810002232731	trichloroethylene, t
nsn:	6810002854318	6810002854318	trichloroethylene, t
*nsn:	6810002854318	6810006560679	trichloroethylene, a
nsn:	6810010315512	6810006784418	trichloroethylene, t
*nsn:	6810001844794	6810007542813	trichloroethylene, t
*nsn:	6810009247107	6810008046185	trichloroethylene, t
nsn:	681000d000088	6810008129181	trichloroethylene, t
*nsn:	6810001844794	6810008377574	trichloroethylene, a
*nsn:	6810001844794	6810009247107	trichloroethylene, t
*nsn:	6810001844800	6810009441039	trichloroethylene, a
*nsn:	6810002232731	6810010160375	trichloroethylene, t
*nsn:	6810002232731	6810010160376	trichloroethylene, t
*nsn:	6810002232731	6810010188951	trichloroethylene, t
nsn:	6810006784418	6810010315512	trichloroethylene, t
*nsn:	6810007542813	6810010698163	trichloroethylene, a
nsn:	6810008129181		
*nsn:	6810008129181	19 NSNs contained in supply system	
*nsn:	6810008129181	for tce procurement.	

HMIS contains 21 records
for tce, 10 unique NSNs

* repeated NSN

solubility:	0.01	evaporation rate:	no data
solubility:	0.1 g/100 gm	evaporation rate:	no data
solubility:	0.16/1000 g	evaporation rate:	no data
solubility:	no data	evaporation rate:	no data
solubility:	no data	evaporation rate:	no data
solubility:	no data	evaporation rate:	0.001 max.
solubility:	no data	evaporation rate:	no data
solubility:	0.1 gm/100 gm	evaporation rate:	no data
solubility:	0.1 gm/100 gm	evaporation rate:	no data
solubility:	negligible	evaporation rate:	0.28, ether
solubility:	0.1 gm/100	evaporation rate:	no data
solubility:	0.11 %	evaporation rate:	0.28, ethyl ether
solubility:	no data	evaporation rate:	no data
solubility:	negligible	evaporation rate:	no data
solubility:	0.16 m/100 gm	evaporation rate:	no data
solubility:	insoluble	evaporation rate:	2.5-ethyl ether
solubility:	0.1 g/100 g	evaporation rate:	no data
solubility:	slight	evaporation rate:	no data
solubility:	0.001	evaporation rate:	no data
solubility:	0.1 gm/100 gm	evaporation rate:	no data
solubility:	0.1 gm/100 gm	evaporation rate:	no data

decomposition products:	open flames & welding arcs=hcl, and very small amounts of phosgen and cl
decomposition products:	hcl and small amounts of phosgene and chlorine
decomposition products:	hydrogen chloride, small amounts of phosgene/chlo
decomposition products:	no data
decomposition products:	no data
decomposition products:	n/a
decomposition products:	n/a
decomposition products:	hcl, very small amounts of phosgene and chlorine
decomposition products:	hcl, small amounts of phosgene and chlorine
decomposition products:	hcl during thermal decomposition
decomposition products:	hydrogen chloride and small amounts of phosgene and chlorine

Figure 3. Raw HMIS Data for 95 to 100 percent pure trichloroethylene.

```
decomposition products:  hydrochloric acid and traces of phosgene
decomposition products:  no data
decomposition products:  toxic and corrosive chlorides
decomposition products:  if heated-hydrogen chloride, small amount phosgene,
                          chlorine
decomposition products:  corrosive acid fumes
decomposition products:  hydrogen chloride, small amounts phosgene and
                          chloride
decomposition products:  no data
decomposition products:  open flames and welding arcs evolves hcl and
                          phosgene and chlorine
decomposition products:  open flames and welding arcs evolves:  hcl
                           and small amount phosgene and cl
decomposition products:  hydrogen chloride, phosgene and chlorine

protective equipment:  full face mask (mk) w/org. canister for levels
                       up to 2%
protective equipment:  no special protective clothing needed, eye wash
                       stus, safetshw
protective equipment:  none required
protective equipment:  no data
protective equipment:  no data
protective equipment:  aprons and boots
protective equipment:  as appropriate to prevent skin contact
protective equipment:  eye wash stations and safety showers
protective equipment:  no data
protective equipment:  when cleaning tanks never enter until safe, or use
                       air respir
protective equipment:  no data
protective equipment:  safety shoes, eye-wash fountain
protective equipment:  no data
protective equipment:  apron, boots
protective equipment:  eye wash stations and safety showers
protective equipment:  no data
protective equipment:  none special
protective equipment:  aprons, boots
protective equipment:  chemical goggles, aprons, boots
protective equipment:  eye wash stations and safety showers should be readily
                       available
protective equipment:  as required


flash point:  n/a
flash point:  n/a
flash point:  none
flash point:  no data
flash point:  no data
flash point:  n/a
flash point:  none
flash point:  n/a
flash point:  n/a
flash point:  n/a
flash point:  none
flash point:  none
flash point:  no data
flash point:  n/a
flash point:  none
flash point:  none
flash point:  none
flash point:  none
flash point:  none
flash point:  n/a
flash point:  none
```

Figure 3. Cont'd.

unusual hazards: no data
unusual hazards: not considered a flammable liquid hazard under normal industrial use
unusual hazards: strong unpleasant odor, not considered a flamm. liquid under normal industrial
unusual hazards: no data
unusual hazards: no data
unusual hazards: n/a
unusual hazards: n/a
unusual hazards: no data
unusual hazards: no data
unusual hazards: vapors can be decomposed by intense heat or open flames releasing hcl
unusual hazards: not considered a flammable liquid hazard under normal industrial use conditions
unusual hazards: vapors can be ignited by high intensity source of ignition, can decompose
unusual hazards: no data
unusual hazards: when heated to decomposition it emits highly toxic fumes of chlorides
unusual hazards: no data
unusual hazards: contact with flames/hot surfaces may form corrosive acid fumes
unusual hazards: not considered a flammable liquid hazard under normal industrial use conditions
unusual hazards: n/a
unusual hazards: no data
unusual hazards: no data
unusual hazards: no data

Figure 3. Cont'd.

```
 nsn:  6810001388414
 nsn:  6810002010989
 nsn:  6810002522144
 nsn:  6810002572479
 nsn:  6810002572480
 nsn:  6810002904166
 nsn:  6810005844070
 nsn:  6810005844071
 nsn:  6810005986600
 nsn:  6810007534787
*nsn:  6810007534787

10 unique NSNs for xylene in HMIS
out of 26 contained in Federal
Supply System
```

```
6810000688867  xylene, technical
6810000722924  xylene, technical
6810000863627  xylene, technical
6810000993400  xylene, reagent
6810001388414  xylene, acs
6810001497005  xylene, acs
6810002522144  xylene, technical
6810002572479  xylene, technical
6810002572480  xylene, technical
6810002904166  xylene, technical
6810004317758  xylene, acs
6810004976395  xylene, reagent
6810005844070  xylene, technical
6810005844071  xylene, technical
6810005986600  xylene, technical
6810007534787  xylene, acs
6810007534788  xylene, acs
6810008200496  xylene, acs
6810008902055  xylene, reagent
6810009054303  xylene, acs
6810009582207  xylene, acs
6810010178296  p-xylene, analyzed r
6810010319532  xylene, technical
6810010351950  xylene, reagent
6810010634535  xylene, acs
6810010698162  xylene, reagent
```

vapor density:	no data	volatile:	no data
vapor density:	no data	volatile:	no data
vapor density:	no data	volatile:	no data
vapor density:	no data	volatile:	no data
vapor density:	no data	volatile:	no data
vapor density:	no data	volatile:	no data
vapor density:	no data	volatile:	no data
vapor density:	no data	volatile:	no data
vapor density:	3.7	volatile:	100
vapor density:	no data	volatile:	no data
vapor density:	n/a	volatile:	n/a

decomposition products:	no data
decomposition products:	no data
decomposition products:	no data
decomposition products:	no data
decomposition products:	no data
decomposition products:	no data
decomposition products:	no data
decomposition products:	no data
decomposition products:	thermal decomposition may yield carbon monoxide
decomposition products:	no data
decomposition products:	n/a

Figure 4. Raw HMIS data for xylene.

Of greater concern than erroneous physical/chemical data are errors in the qualitative data concerning proper handling procedures. Three of the records recommend water spray as an extinguishing medium, two others say that water spray is ineffective, and the other eight records do not even mention it. Similarly, under the "unusual hazards" category, two of the records indicate there are none, while others indicate MEK is a serious fire hazard and reacts with oxidizers. Under "conditions to avoid," both "none" and "heat, sparks, and open flame" are indicated in separated records. Under "incompatible materials," "none," "oxidizers" and "alcohol, amines, pyridines, ammonia, caustics, inorganic acids" are given in separate records. Under "decomposition products," "none" and "carbon monoxide" are indicated. These kinds of inconsistencies are common throughout the database. Figures 3 and 4 show similar examples for trichloroethylene and xylene.

The biggest problem with these errors is that HMIS has been marketed as an NSN-based system. Most users are accustomed to using the database by entering it with one NSN, rather than by selecting a chemical name that would allow comparison of the data. The user who selects by one NSN has a 50/50 chance of getting no data; of the data obtained, there is another 50/50 chance that it is correct. Moreover, without referring to outside information, the user who selects all the records pertaining to a particular chemical still will not know which records contain correct information.

4 CONCLUSION

This report has described the development and use of a program that allows interactive searches of the Hazardous Materials Information System (HMIS) safety and transport databases. The interactive program was also used to assess the completeness, consistency, and validity of data contained in the HMIS database.

It was found that the data are incomplete, inconsistent, and in many cases, incorrect. Users of the interactive programs are therefore urged to conduct searches, using assigned search terms rather than national stock numbers, so that as many records as possible pertaining to the same chemical compound can be retrieved and compared.

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